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March, 1983.

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REPORT ON INVESTIGATION OF SOIL AND VEGETATION CONDITIONS IN THE VICINITY OF CANADIAN PACIFIC RAILROAD SIDING AT LEVACK STATION

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INTRODUCTION:

In 1976, staff of the Air Quality Assessment group observed that vegetation was dead or stunted in growth in the drainage courses in the vicinity of the Canadian Pacific Railroad siding at Levack Station. An investigation of the situation in September of that year demonstrated that high concentrations of copper, nickel, iron and cobalt in soil were associated with the railroad siding (internal memo). Highly contaminated runoff water from the site was apparently able to enter Windy Creek. This was confirmed in investigations conducted by staff of Water Resources Assessment in 1977 and 1978. Following the discovery in 1981 that water wells in the same area were contaminated by some of the same metal elements found earlier, a more detailed investigation of the condition of soil and vegetation was undertaken in 1982. This report summarizes the available data collected from the 1982 investigation of the site.

METHODS AND SITE DESCRIPTION:

Highway 144 runs parallel to a siding of the Canadian Pacific Railroad for approximately 1200 m at Levack Station (Figure 1). In this same location, Windy Creek, which drains from Windy Lake, approximately parallels the highway on the side of the highway opposite the railroad. The railroad tracks at this point are located on top of an embankment which ranges up to 10 metres high. A second area of rail sidings is located in a relatively level area west of the crossing of the CPR and Highway 144 and extends for approximately 500 metres. On both sets of sidings, open top gondola cars of metal ore concentrate were stored for various periods of time prior to shipment to Sudbury area smelters.

During the 1976 investigation, it was noted that the rail embankments were largely devoid of vegetation. The area between the highway and the stream were also noted as having areas where vegetation was killed. The areas of killed vegetation were associated with drainage areas originating at culverts passing below the highway. Samples of water taken in these drainage areas were found to contain high concentrations of nickel, copper, iron and cobalt.

During the 1982 investigation, vegetation cover in the vicinity of the railroad tracks was evaluated. The vegetation cover was rated as either healthy, killed or revegetated. The first categories were relatively easy to distinguish. Revegetated areas were restricted to the railroad embankment which had an added a cover of sand but the grass cover on the sand was very sparse. It is not known who had carried out this revegetation attempt.

Samples of soil from three depths (0-5, 5-10 and 10-15 cm) were collected at 15 locations associated with the track study area. These locations are shown in Figure 1. Descriptions and locations of the sites are summarized in Table 1. Samples were air dried, ground by hand to pass through a 45 mesh seive and forwarded to the laboratory for chemical analysis. The analyses performed included copper, nickel, iron, sulphur, lead, cadmium, zinc, manganese, sodium and chloride.

RESULTS:

The areas of vegetation damage are shown in Figure 1 (Maps A, B, C, D). Generally, there are three areas of rail embankment where revegetation had been attempted. These areas include a strip about 300 metres long extending east from the Highway 144-CPR crossing, a narrow strip about 200 metres long directly across the highway from the homes at Levack Station and a narrow strip about 200 metres long near the east end of the siding. All revegetated areas were located on the south side of the embankments but the vegetation cover was rather sparse.

Aside from the area of the track itself, there were a number of other areas which were devoid of vegetation. Except as noted above where revegetation efforts had taken place, most embankments were devoid of vegetation. Several small areas of dead vegetation were noted on the north side of the tracks.

The base of the embankment at several locations along the siding had large areas with no vegetation. Small patches of dead vegetation were found on the bank of Windy Creek and one of these appeared to be associated with drainage from a culvert (Site 9). The most prominent vegetation kill (Sites 4, 5, 7) near the east end of the siding had been observed in 1976. In 1982, the zone was about 25m wide and had extended to the edge of the creek. Alder shrubs in the area had been killed but a few tufts of living grasses remained in the zone.

Vegetation kill was observed on the embankments of the CPR mainline between the CPR-Highway 144 crossing and Windy Creek. Vegetation in the vicinity of the small creeks at the bottom of both sides of this embankment were apparently affected as well.

In the western most siding area, the land was formerly a bog. Extensive vegetation kill was noted in the area encircled by the various tracks in the area as well as in a strip along the southern edge of the rail siding. The pattern of affected vegetation appeared to be related to high water levels as might be encountered under spring runoff conditions.

The chemical analysis results are presented in Table 2. The concentrations of lead, cadmium, zinc, manganese, sodium and chloride all fall well within the concentration range considered to be normal for each respective element and will not be considered further. Iron concentrations in soil exceeded 10 percent at only one station (Site 1). At Site 8, the soil iron content exceeded 5% while the soil at all other sites contained was less than 5% iron.

The sulphur concentration exceeded 1 percent in soil samples collected at Sites 1, 2 and 12. Sulphur values were also slightly elevated (over 0.5%) at Sites 8, 14 and 15. The samples collected at the remaining sites were within the normal concentration range for sulphur.

Copper and nickel values were considered to be excessive in soil samples from all sites except Site 3 and Site 6. At Site 3, the soil was

introduced sandy material spread over the embankment to act as a seed bed for revegetation purposes while Site 6 served as a check, undisturbed site. Soils from the contaminated sites contained between 270 and 2520 µg/g copper and 130 and 2250 µg/g nickel in the surface layer. Some soils profiles showed a gradient with highest metal content in the upper levels but this was not consistent throughout all sites.

CONCLUSIONS:

Vegetation in proximity to the CPR siding at Levack Station was found to have been killed on the railroad embankment and along watercourses draining from the siding area. It was concluded that the vegetation had been killed by materials lost from the rail cars which were allowed to sit on the siding for various periods of time. The high concentrations in copper and nickel which were found in the soil support this conclusion since the concentrations encountered are sufficient to cause the vegetation to be killed.

From the pattern of vegetation damage, one must conclude that contaminated runoff from the siding area is reaching and contributing to the contamination of Windy Creek. Removal of contaminated overburden may or may not solve the well contamination problem since this material was contaminated to depths over 15 cm. The full extent (depth) of contamination is not known. Replacement of surface material could be carried out but success in revegetating the railroad bank could be difficult due to the steep slopes of the railroad embankment which is subject to erosion. Further, the embankment is subject to drought due to the excessive drainage and high temperatures created by the southern exposure. These problems are not present in the level areas.

While it would be possible to improve aesthetically, the appearance of the site, it is beyond the scope of the present study to determine if such an effort would have any effect on improving the quality of well water in the area. Before reclamation (ie. revegetation) of the surface is undertaken, it is necessary to know whether the site will have to first be altered in some other way (ie. removal of tracks and rail bed). Such costs must be justified by demonstrating that the rail bed is indeed connected with the contamination of the ground water. It would not be expedient to revegetate the surface areas, only to have the work destroyed by subsequent disturbance.

TABLE 1: SUMMARY OF SITE LOCATION AND SITE DESCRIPTIONS FOR SOIL SAMPLING LOCATIONS ESTABLISHED IN THE VICINITY OF CPR SIDINGS AT LEVACK STATION

SITE NO.	UTM COORDINATES	GENERAL DESCRIPTIONS OR COMMENTS
1	468520-5160950	"Dead" bog area with iron deposits.
2	469750-5161230	Base of embankment, gravelly clay, red brown colour, no vegetation.
3	469756-5161240	Railroad embankment, sandy cover about 15-20cm deep, sparse seeded grass cove
4	469730-5161170	Middle drainage channel, vegetation killed, wet clay, iron deposits on gravel
5	469760-4161180	Edge of killed vegetation in drainage channel, killed alder and woody litter on surface.
6	469780-5161180	Healthy alder bog; "check" site.
7	469750-5161040	Middle of drainage channel, 25m from Windy Creek, clay soil, dead grass, algae growth on surface.
8	469540-5161010	Base of rail embankment, no vegetation.
9	469550-5160970	On stream bank, downstream from culvert draining site 8, vegetation dead.
10	469500-5160940	On stream bank, vegetation dead; immediately east of most easterly house of Levack station group.
11	469470-5160980	Base of embankment, north side, vegetation killed.
12	469230-5160720	Base of embankment, no vegetation.
13	469230-5160720	Base of embankment, north side, vegetation killed.
14	468430-5160950	"Dead" bog area, south side of track at most westerly end of siding area.
15	468459-5160940	"Healthy" bog area, south of Site 14.

TABLE 2: CONCENTRATIONS OF VARIOUS CHEMICAL ELEMENTS IN SOIL SAMPLES COLLECTED IN THE VICINITY OF THE CPR TRACKS AT DOWLING JULY 5, 1982

		ELEMENTS (µg/g)									
SITE	DEPTH	COPPER	NICKEL	IRON	SULPHUR (%)	LEAD	CADMIUM	ZINC	MANGANESE	SODIUM	CHLORIDE (%)
1	0-5cm	975	462	119000	2.48	20	<.5	25	31	380	.04
	5-10cm	750	200	158000	1.83	8	<.5	21	22	135	.04
	10-15cm	425	300	96200	1.01	5	<.5	15	20	95	.01
2	0-5cm	2520	2250	34000	1.79	80	.5	58	122	900	.02
	5-10cm	4020	4450	33500	1.90	68	1.5	99	135	255	.02
	10-15cm	1220	3900	21500	1.67	52	2.0	112	132	205	.01
3	0-5cm	81	69	7880	.03	8	<.5	20	146	85	.02
	5-10cm	41	26	6880	.02	5	<.5	18	140	68	.03
	10-15cm	29	20	7380	.04	5	<.5	18	140	75	.02
4	0-5cm	270	130	16600	.19	22	<.5	28	125	255	.01
	5-10cm	238	130	15400	.15	32	<.5	34	115	280	.01
	10-15cm	338	112	19200	.22	38	<.5	32	108	260	<.01

ELEMENTS (µg/g)

SITE	DEPTH	COPPER	NICKEL	IRON	SULPHUR (%)	LEAD	CADMIUM	ZINC	MANGANESE	SODIUM	CHLORIDE (%)
5	0-5cm	450	400	20900	.20	32	<.5	47	182	600	.02
	5-10cm	200	270	10100	.08	10	<.5	44	170	425	.10
	10-15cm	164	170	8750	.06	8	<.5	36	194	140	.01
6	0-5cm	29	41	11100	.06	12	<.5	31	178	110	.12
	5-10cm	14	22	11100	.03	5	<.5	23	140	95	.07
	10-15cm	10	25	8750	.02	5	<.5	18	140	88	.09
7	0-5cm	300	170	21900	.09	15	<.5	29	101	280	.01
	5-10cm	242	172	7750	.07	12	<.5	36	85	108	.10
	10-15cm	215	338	7250	.11	8	<.5	40	82	112	.08
8	0-5cm	938	132	70000	.98	82	<.5	29	105	625	.01
	5-10cm	938	115	55500	.69	65	<.5	28	110	395	.07
	10-15cm	400	25	36500	.48	42	<.5	24	122	250	.02
9	0-5cm	288	355	19200	.26	22	<.5	34	125	195	.01
	5-10cm	600	950	19200	.24	50	<.5	51	132	195	.01
	10-15cm	45	225	13900	.25	42	<.5	48	125	190	.01
10	0-5cm	675	375	21200	.31	82	<.5	58	120	825	.03
	5-10cm	425	365	8380	.14	25	<.5	54	96	395	.01
	10-15cm	238	350	7500	.11	8	<.5	54	94	308	.01

ELEMENTS (µg/g)

SITE	DEPTH	COPPER	NICKEL	IRON	SULPHUR (%)	LEAD	CADMIUM	ZINC	MANGANESE	SODIUM	CHLORIDE (%)
11	0-5cm	412	145	12500	.20	20	<.5	24	108	165	<.01
	5-10cm	131	64	11900	.07	12	<.5	21	105	110	<.01
	10-15cm	90	60	26800	.08	38	<.5	24	136	122	<.01
12	0-5cm	1440	312	29000	.09	35	<.5	26	114	185	<.01
	5-10cm	2290	488	26800	1.30	38	<.5	29	111	130	<.01
	10-15cm	1760	712	23200	1.06	30	.5	27	116	130	.01
13	0-5cm	265	826	20100	.17	32	<.5	24	131	225	.01
	5-10cm	201	625	17500	.12	28	<.5	21	121	152	.01
	10-15cm	125	550	12200	.07	18	<.5	17	105	135	.01
14	0-5cm	1960	775	14000	.80	8	<.5	28	40	122	<.01
	5-10cm	1720	550	20000	.61	9	<.5	18	29	85	.02
	10-15cm	1760	350	3950	.59	5	<.5	8	21	45	.03
15	0-5cm	1240	1500	18400	.73	32	<.5	44	68	192	.01
	5-10cm	975	638	12900	.61	28	<.5	13	21	90	.01
	10-15cm	1140	725	4500	.77	22	<.5	12	24	85	.01

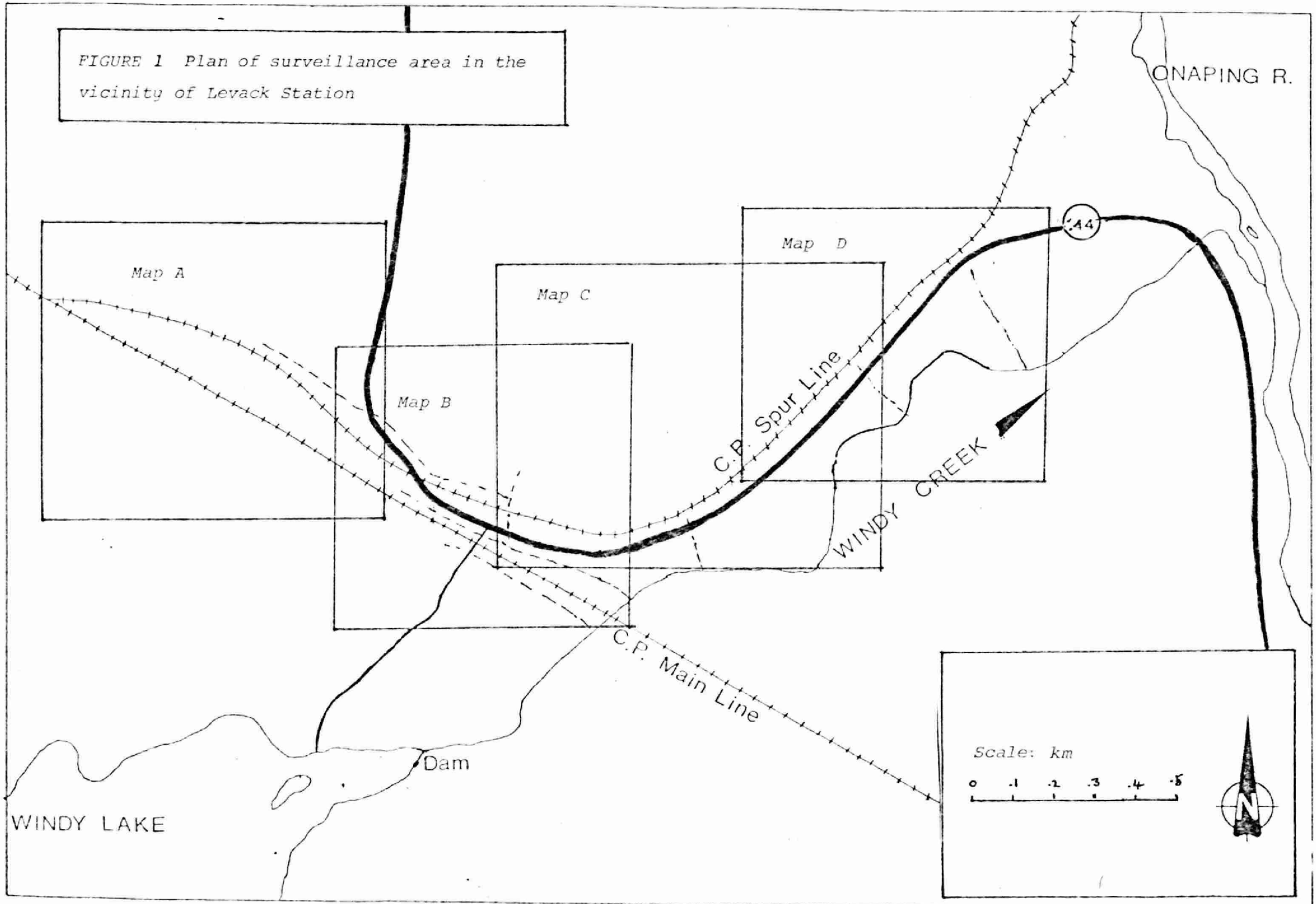
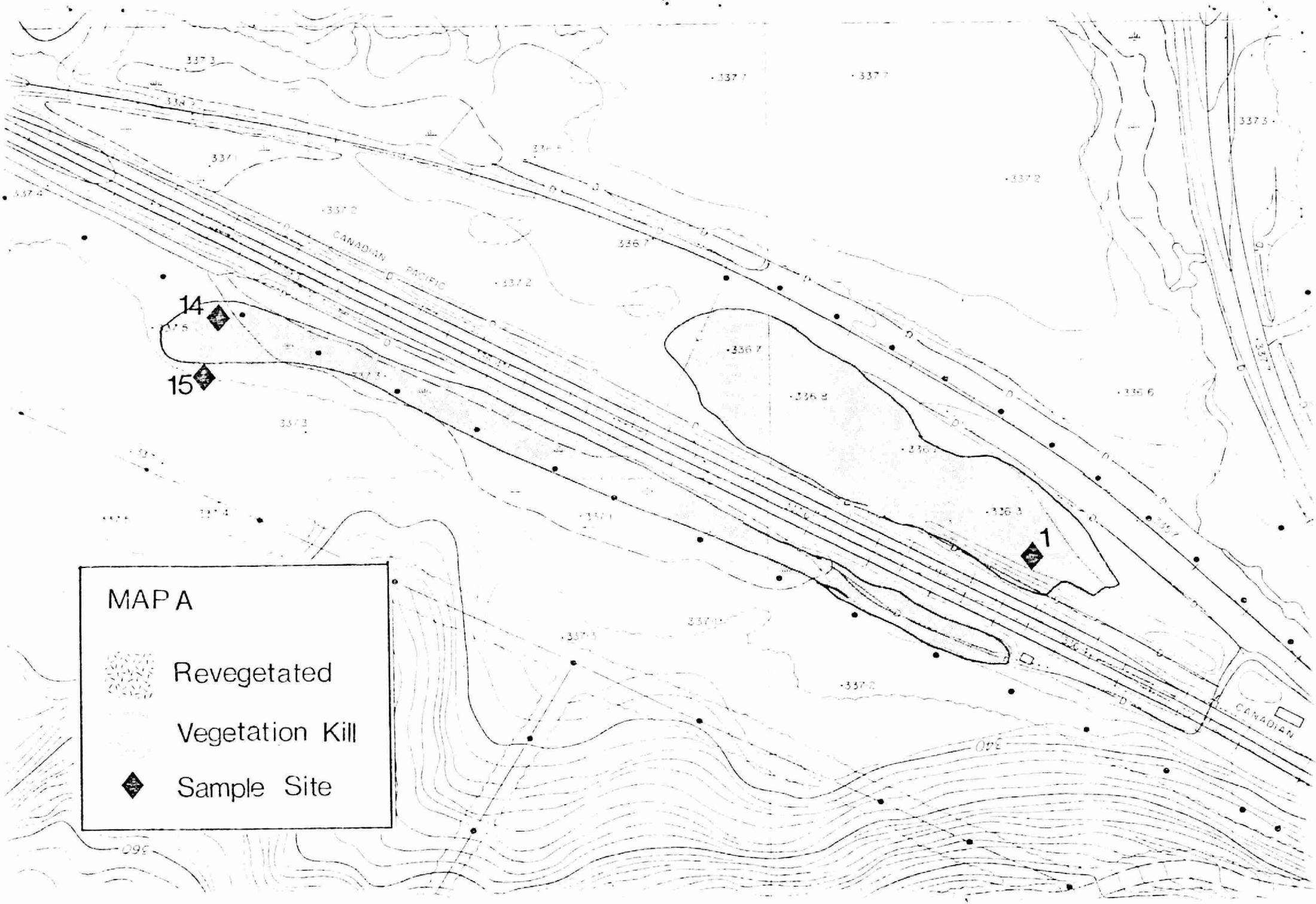
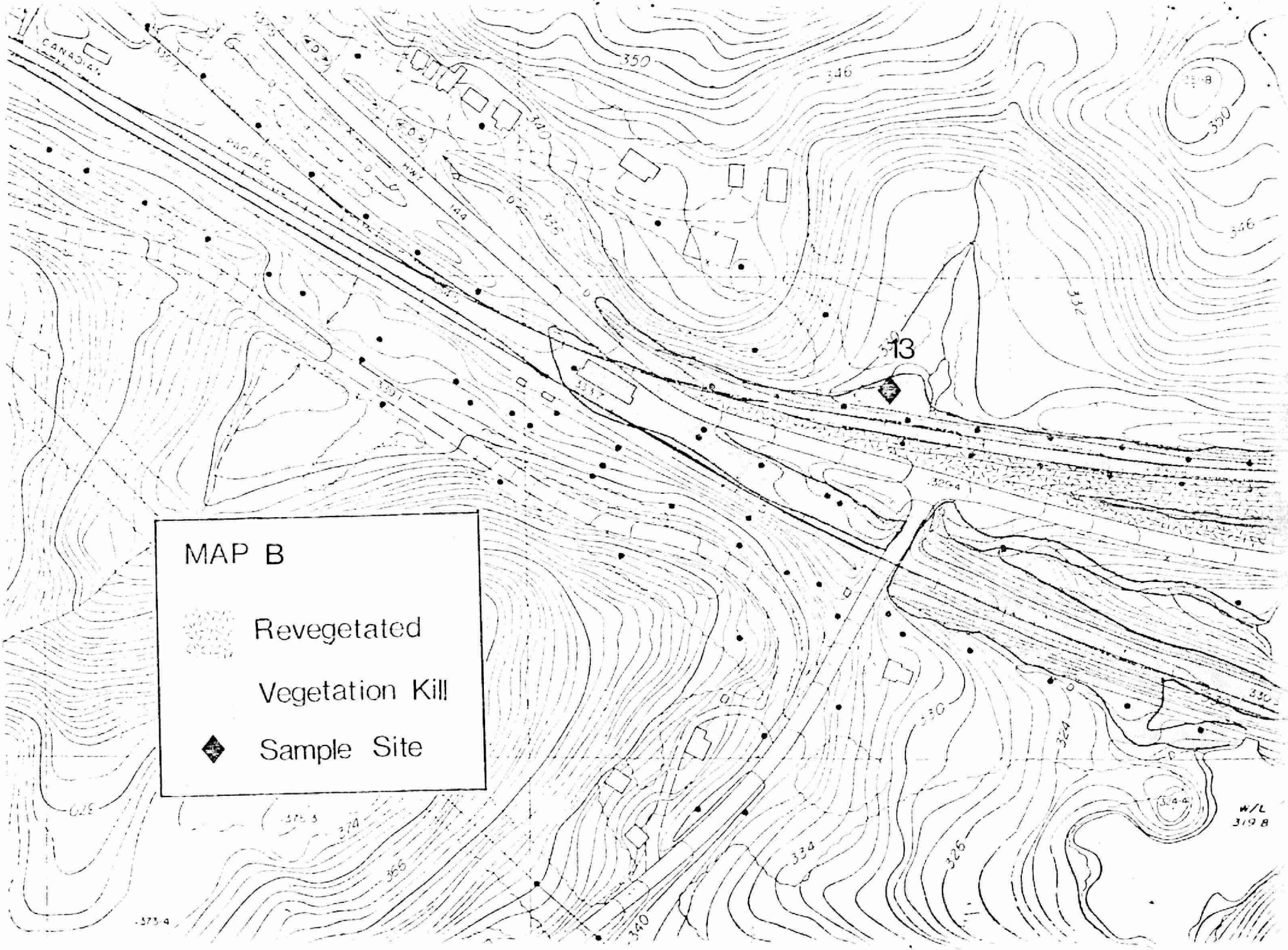
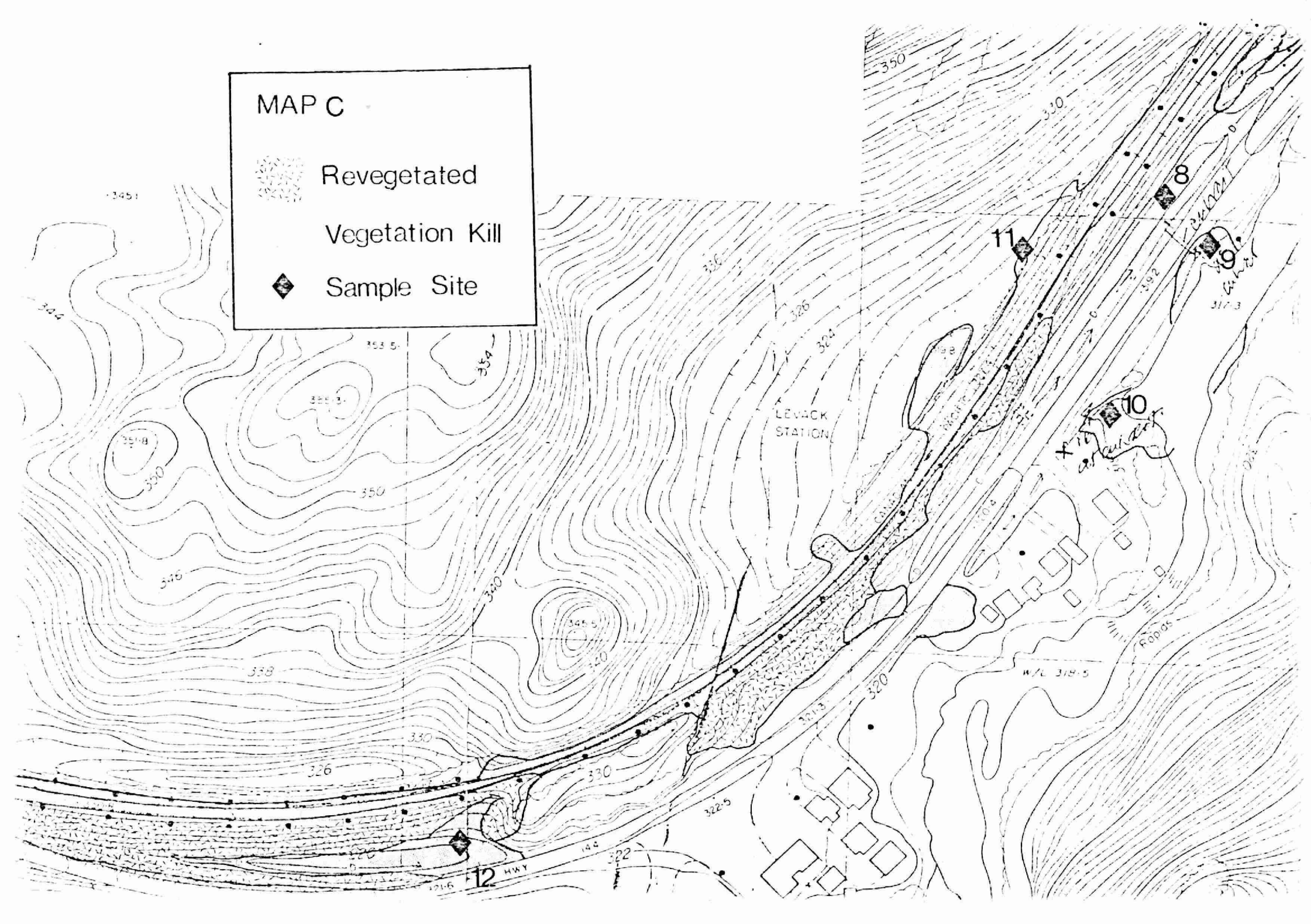
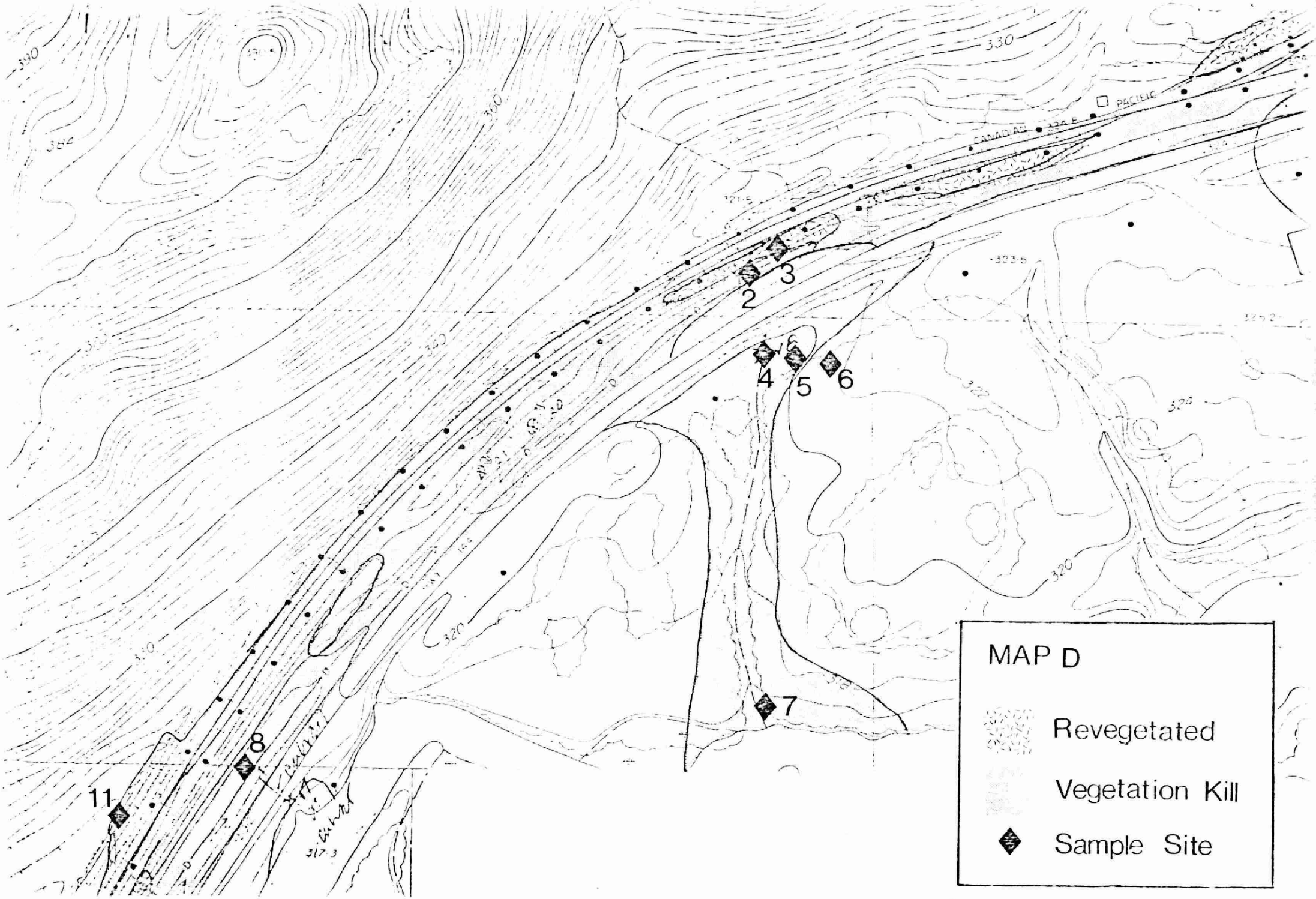


FIGURE 1 Plan of surveillance area in the vicinity of Levack Station


MAP A
Revegetated
Vegetation Kill
Sample Site
14
15
1
CANADIAN PACIFIC
CANADIAN


MAP B
Revegetated
Vegetation Kill
Sample Site
13
CANADIAN
PACIFIC
HWY
W/L
319.8


MAP C
Revegetated
Vegetation Kill
Sample Site
LEVACK STATION
HWY
8
9
10
11
12


MAP D
Revegetated
Vegetation Kill
Sample Site
1
2
3
4
5
6
7
8
11

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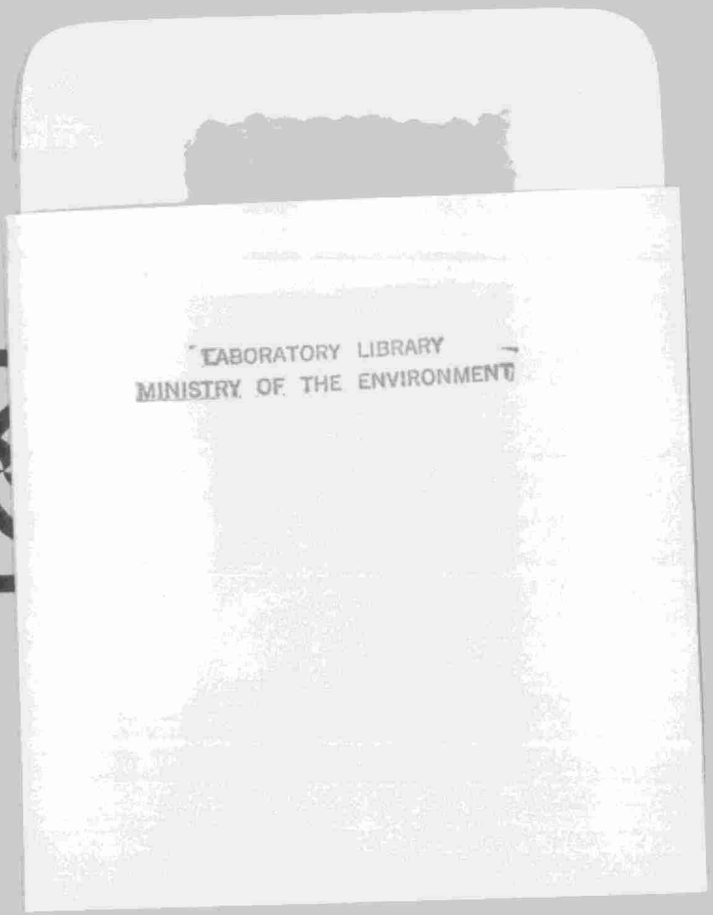

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